

Black and white reversal film developing process with caffanol-c + citric hydrogen peroxide bleach

Although the use of coffee as a beverage exists noticeably since the 13th century, its use as a film developer is very recent. Actually, the first reference to successful experiences date back to 1995 through Dr. Scott Williams and his Technical Photography Class in Rochester Institute of Technology (R.I.T.). Their idea was to create a film developer with simple components. Caffeine beverages seemed to be the most efficient substances, so coffee was chosen. Their developer was baptized "caffenol" in 2000. The idea to use ascorbic acid (vitamin-c) as an additional component came later and it's usually referred to as caffanol-c.

I started to develop my own super8 films in 1999. I used old formulas, and mixed my own chemistry. I worked mainly in black and white reversal film, both in super8 and 16mm. I used toxic chemistry in developer and bleach, like metol, hydroquinone or potassium dichromate among others. In 2013, after my younger son was born I decided to research low toxicity chemistry for film developing, because I wanted to be safe and also to keep my family safe. Some months later my doctor said I should be careful handling such chemistry, so I decided to explore new possibilities. I began using caffanol-c, the first experiences were good and I quickly became an enthusiast. But for using it with my favourite film, emulsion (black and white reversal) I had to use a safer bleach. I contacted Dr. Scott Williams, and asked for his opinion, he answered in the same day, and we started to exchange ideas. His first suggestion was to use ferric EDTA as a bleach agent, together with potassium bromide. But this meant that the bleach would be a rehalogenating bleach, and it wouldn't allow the use of caffanol-c as a developer. So I started to search for simple oxidizing agents that could allow a non-rehalogenating bleach, that way I could keep the caffanol as a developer, since this was my main goal. I came up with hydrogen peroxide, because I found some old formulas and some research mentioning it as a possible ingredient for a non-rehalogenating bleach. I started to test 35mm bw reversal FOMAPAN R100 still film. First strips got black, no image at all. I kept using hydrogen peroxide but with different dilutions. The first successful test I got was using a undiluted 9% hydrogen peroxide solution as bleach. The pH value was 2.68 at 24°C (image1).



Image1 – 35mm fomapan R100 reversal bw film still, 9% hydrogen peroxide bleach

Still the image showed incomplete bleaching, stains, blisters and a strong yellow brown tone. I decided to add a stabilizer, first option was adding phthalic acid. I could observe that the hydrogen peroxide seemed more stable right after mixing both. The result was much better, the bleaching was complete, the image didn't have so many blisters, and it got black and white with no toning (image2).



image2 – 35mm fomapan R100 reversal bw film still, 9% hydrogen peroxide bleach + phthalic acid

Phthalic acid seemed a good stabilizer, but still it wasn't something I could find in a drugstore, so again I emailed Dr. Scott, who suggested me to use citric acid (or lemon juice) as a stabilizer, instead of phthalic acid. So I bought some limes, made some lime juice, and added 100ml to 400ml of 9% hydrogen peroxide, once again I noticed that hydrogen peroxide got more stable in dilution, the pH was 2.65 at 24°C. So I developed another filmstrip, in reexposure I could immediately see that the image looked good, but I must say I was even more surprised in the end. The image looked very good, again with a yellow brown tone, but with complete bleaching and much more stability, blisters were still there, but they seemed to add a special look to it (image3). So I decided to keep using it just like that. I will still try to improve it, but I became a big enthusiast of caffeinol-c and lemon-hydrogen peroxide bleach. I decided to write the formula down, I hope you try it, and I hope you like it as much as I did. This will be a perfect way to use a film developing process with very low toxicity, but also to obtain beautiful yellow brown tone images. I'm still testing a new bleach, based on hydrogen peroxide but with increased stability, I will keep you informed of my progress. If interested, please contact me on my laboratory email: atomo47@gmail.com

Thank you Dr. Scott Williams, not only for inventing Caffenol, but for helping me to find the right formulation for a lemon-hydrogen peroxide bleach. Additional thanks to Richard Tuhoy and Kevin Rice for their help too.



Image3 – 35mm fomapan R100 reversal bw film still, 9% hydrogen peroxide bleach + lime juice



Image4– 35mm fomapan R100 reversal bw film still, 9% hydrogen peroxide bleach + lime juice skipping clearing bath

I will now present the chart and formula for developing. You can follow all steps or skip or even modify them and still have decent results. In one of my last tests, i decided to skip the clearing bath, and the results were very satisfactory, in fact, the image looked better but with a stronger brown tone and increased contrast (image4).

Reversal black & white film developing steps and formula

STEP	SHORT DESCRIPTION
1 st DEVELOPER	Develops the exposed light-sensitive silver halide crystals to metallic silver (a negative image). Time and temperature control are critical for optimum results.
WASHING	Removes first developer from the film.
BLEACH	Dissolves the metallic -silver negative image produced in the first developer but does not affect the remaining silver halide.
WASHING	Removes excess bleach from the film.
CLEARING BATH	Removes any bleach left from the wash step and prepares the film f or redevelopment. (you can use it, but i already skipped this step and got good result)
WASHING	Removes clearing bath from the film
RE-EXPOSURE TO LIGHT	Exposes the silver halide crystals that were not exposed in the camera
2 nd DEVELOPER	Develops remaining exposed silver halide to produce a positive image.
WASHING	Removes second developer.
FIXER	Removes any undevel oped silver halide grains. This step should yield minimal silver.
FINAL WASH	Removes fixer from the film
WETTING AGENT	Helps drying the film minimizing spots
DRYING	Dries the film, preparing it for projection

Caffenol-C + lemon-hydrogen peroxide b&w reversal process – FORMULA for 1000ml

HIGH CONTRAST CAFFENOL-C – DEVELOPER (1 st and 2 nd)	
Heat distilled water up to 38C° to help dilution around 500ml	
Coffee (diluting coffee)	50grams
Sodium carbonate	60grams
Ascorbic acid	25grams
Potassium bromide	2grams
Mix and add distilled water up to 1000ml – ph should be between 10-11 at 24C°	

BLEACH – LEMON-HYDROGEN PEROXIDE 9%	
Hydrogen Peroxide	800ml

Lemon or lime juice (filtered)	200ml (each lemon or lime contains around 47 grams of citric acid per liter of juice, so 200ml should contain around 9 grams of the acid)
Mix and add distilled water up to 1000ml – ph should be around 2-3 at 24C°	

CLEARING BATH (you can use it, but i already skipped this step and got good result)	
Heat distilled water up to 38C° to help dilution around 500ml	
Sodium Sulfite	90grams
Mix and add distilled water up to 1000ml	

FIXER	
Heat distilled water up to 38C° to help dilution around 400ml	
Sodium Thiosulfate	250grams
Sodium Metabisulfite	25grams
Mix and add distilled water up to 1000ml	

Times of development: FOMAPAN R100 REVERSAL FILM

Process	Temperature	Time (minutes)
1 st developer (caffenol-c)	28-30C°	17-20
Wash	28-30C°	10
Bleach (lemon-hydrogen)	38C°	11:30
Wash	28-30C°	5
Clearing bath	28-30C°	2
Wash	28-30C°	5
Reexposure 300W at 1 meter		2:30
2 nd developer (caffenol-c)	28-30C°	20
Wash	28-30C°	10
Fixer	25-30C°	5
Final Wash	25C°-30C°	15-25
Wetting agent	20-30C°	2